IERA-RS-BR-SR-2003-0002

UNITED STATES AIR FORCE
IERA

Aircraft/Auxiliary Power Units/Aerospace Ground Support Equipment Emission Factors

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October 2002

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REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	October 2002	Final Jun 02-Oct 02

4. TITLE AND SUBTITLE
Aircraft/Auxiliary Power Units/Aerospace Ground Support Equipment Emission Factors

5. FUNDING NUMBERS

6. AUTHOR(S)
Mark D. Wade

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Karta Technologies Inc.
5555 Northwest Parkway
San Antonio, TX 78249

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Air Force Institute for Environment, Safety and Occupational Health Risk Analysis
Risk Analysis Directorate
Environmental Analysis Division
2513 Kennedy Circle
Brooks City-Base, TX 78235-5116

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
IERA-RS-BR-SR-2003-0002

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT
Approved for public release, distribution is unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The report provides aircraft engine, auxiliary power unit, and ground support equipment operation information and emission factors for military and commercial aircraft operations. This data has been provided in a format that can be used to calculate Air Force runway emissions for military and commercial aircraft, auxiliary power units, and ground support equipment. The organization calculating the emissions will still need to determine average atmospheric mixing heights and landing /takeoff number and time parameters.

14. SUBJECT TERMS
Mobile Source Emission Inventories, Conformity Reviews, Aircraft Engine Emissions, Aircraft
Auxiliary Power Unit Emissions, Ground Support Equipment

15. NUMBER OF PAGES
68

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	unclassified	UL

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ABBREVIATIONS AND ACRONYMS

AB	afterburner
AFB	Air Force Base
AFIERA	Air Force Institute for Environment, Safety & Occupational Health Risk Analysis
AFIERA/RSEQ	Air Quality & Hazardous Waste Branch of the Air Force Institute for Environment, Safety & Occupational Health Risk Analysis
AGE	aerospace ground equipment
APU	auxiliary power unit
CAA	Clean Air Act
CAAA-90	Clean Air Act Amendments of 1990
CO	carbon monoxide
EDMS	Emissions Dispersion Modeling System
EF	emission factor
FAA	Federal Aviation Administration
gal	gallon(s)
HAP	hazardous air pollutant
HC	hydrocarbons
hp	horsepower
hr	hour(s)
IC	internal combustion
ICAO	International Civil Aviation Organization
lb	pound(s)
LFB	low flyby
LFP	low flight pattern
LTO	landing and takeoff
MAJCOM	Major Command
No.	number
NO_x	oxides of nitrogen (or nitrogen oxides)
PAH	polycyclic aromatic hydrocarbon(s)
Pb	lead
PIC	products of incomplete combustion
PM	particulate matter
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than 2.5 microns
PM_{10}	particulate matter with an aerodynamic diameter less than 10 microns
SO_2	sulfur dioxide
SO_x	oxides of sulfur (or sulfur oxides)
TGO	touch and go
TIM	time in mode
THC	total hydrocarbons
USAF	United States Air Force

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SECTION I
INTRODUCTION

SECTION 1
AIRCRAFT/AUXILIARY POWER UNITS/AEROSPACE GROUND SUPOERT EQUIPMENT EMISSION FACTORS

Introduction

As part of a continuing effort to manage air emissions at Air Force Bases the Air Force Center for Environmental Excellence (AFCEE) requested the Air Quality Branch of the Air Force Institute for Environment, Safety and Occupational Health Risk Analysis (AFIERA/RSEQ) to prepare a document that provides a listing of aircraft and associated mobile flightline emission sources at Air Force Base. The data provided in this document will be used to calculate mobile source emissions from aircraft movements and implementation into the Air Conformity Applicability Model, 3.0. The results of the calculations will be used in mobile source emission inventories, nonattainment planning, and conformity reviews.

An aircraft movement is defined as aircraft landings and takeoffs (LTO), aircraft touch and goes (TGO), and aircraft low fly bys (LFB). An aircraft LTO is defined by the U.S. Environmental Protection Agency and the International Civil Aviation Organization as the cycle time when an aircraft enters the atmospheric mixing zone and lands, taxi time in, idling time at the gate, taxi idle out to the takeoff runway, takeoff, and climb out through the atmospheric mixing zone. The atmospheric mixing zone height is the ceiling height of the layer of the earth's atmosphere where chemical reactions of pollutants can ultimately affect ground level pollutant concentrations. The atmospheric mixing zone height is also known as the height of the inversion layer. A TGO cycle time includes the time when the aircraft enters the atmospheric mixing zone and lands, then immediately takes off, and climbs out through the atmospheric mixing zone. A LFB is similar to a TGO but less time is spent in the takeoff mode.

Each of the cycle operating modes (approach, taxi/idle-in, taxi/idle-out, takeoff, and climb out) is typically associated with a standard power setting for a given aircraft. The aircraft approach is typically associated with the approach (30% power) power setting. The taxi/idle-in and taxi/idle-out operating modes are associated with the idle (7% power) power setting. During takeoff the aircraft typically is operated at either military (100% power) power or at the afterburner (110% to 150% power) settings. During climb out the aircraft engine power setting is typically at intermediate power (70% power).

Tables 2-1, 2-2, and 2-3 provide information on both military and commercial aircraft, aircraft engines, and auxiliary power units. No data is provided on average atmospheric mixing heights or time in mode data. Both of these items are base specific and were not part of this information request.

There are two other sources of emissions that are associated with aircraft movements. Onboard auxiliary power units (APU's) provide ancillary power to the aircraft while it is on the ground and sometimes through takeoff and climbout. APU's are turbine-powered generators, ranging in size from 50 hp to over 400 hp, which burn JP-8 fuel. Another

source of emissions is from the mobile ground support equipment, also referred to as aerospace ground support equipment (AGE). AGE is powered by both reciprocating internal combustion engines and small turbine engines that are primarily fuel by JP-8, but also can burned diesel or in a few cases mogas. AGE includes generators, air conditioners, start carts, heaters, hydraulic test stands, portable light units, air compressors, cargo and bomb lifts, jacking units, aircraft tugs, aircraft deicers, and other service vehicles.

Data on APU's and AGE were obtained from a survey that was developed and distributed by AFIERA/RSEQ to various flight squadrons and AGE shops throughout the Air Force. Where information was not available or could not be obtained from the Air Force, data was obtained from the Federal Aviation Administration (FAA) Environmental Data Management System (EDMS).

Tables 3-1 and 3-2 provide both a list of ground support equipment and operation data for each aircraft. APU data is provided in Tables 2-1, 2-2, and 2-3.

Emission factors for aircraft engines, APU's, and AGE are provided in Tables 4-1, 4-2, 5-1, 5-2, and 6-1. Criteria pollutant emission factors are presented in pounds per hour. All operation times are shown in fractions of an hour.

Emission Calculation Methods

Two separate methodologies are used to calculate actual emissions from aircraft movements and auxiliary power units. Criteria emissions from aircraft movements can be calculated using the following equation:

$$E_{pol} = (EF_{Approach} * T_{Mode}) + (EF_{Taxi\ Idle\text{-}in} * T_{Mode}) + (EF_{Taxi\ Idle\text{-}in} * T_{Mode}) + (EF_{Takeoff} * T_{Mode}) + (EF_{Climb\ out} * T_{Mode}) * E_{Engine} * N_{Cycles}$$

Where,

E_{pol} = Emissions of a particular pollutant (lb/yr)
EF = Emission factor for a pollutant at a specific power setting (lb/hr)
T_{Mode} = Mode time (minutes)
E_{Engine} = Number of engines on aircraft
N_{Cycles} = Number of LTOs, TGOs, or LFBs

APU emissions can be calculated using the following formula:

$$E_{pol} = EF * N_{Cycles} * E_{APUs} * T_{Cycle}$$

Where,

E_{pol} = Emissions of a particular pollutant (lb/yr)
EF = Emission factor for a pollutant at a specific power setting (lb/hr)
T_{Cycle} = Operating time per LTO (hours)
E_{APUs} = Number of APUs on aircraft

N_{Cycles} = Number of LTOs per year

AGE emissions can be calculated using the following formula:

$$E_{pol} = EF * N_{Cycles} * T_{Cycle}$$

Where,

E_{pol} = Emissions of a particular pollutant (lb/yr)
EF = Emission factor for a pollutant for a specific piece of AGE (lb/hr)
T_{Cycle} = Operating time per LTO (hours)
N_{Cycles} = Number of LTOs per year

REFRENCES

1. USAF IERA/RSEQ, IERA-RS-BR-SR-2001-0010, "Air Emissions Inventory Guidance Document for Mobile Sources At Air Force Installations", January 2002.
2. USDOT, "FAA Emissions and Dispersion Modeling System Database" .
3. ICAO, "ICAO Engine Exhaust Emissions Data Bank", February 2002,
4. USAF, "The Engine Handbook", SA-ALC/LR, 1995.
5. Federation of American Scientists, 'U.S. Military Aircraft".
6. USAF, "Aircraft Engine and Auxiliary Power Unit Emissions Characterization Study" , AFIERA, 1999.

SECTION 2
MILITARY AND COMMERCIAL AIRCRAFT ENGINES AND AUXILIARY POWER UNITS

TABLE 2-1
MILITARY AIRCRAFT AND ENGINES

USAF

Aircraft Model	Aircraft Engine (Number)	[1]Auxiliary Power Units (Number)
A-10A/B	TF34-GE-100/-100A (2)	GTCP36-50 (1)
B-1B	F101-GE-102 (4)	GTCP-185-9 (1)
B-2	F118-GE-100 (4)	GTCP131-3A (2)
B-52H	TF33-P-3/103 (8)	
C-5A/B	TF39-GE-1A/-1C (4)	GTCP165-1B (2)
C-9A	JT-8D-9A (2)	GTCP85-98D (1)
KC-10A	F103-GE-101 (2)	TSCP700-4B (1)
C-12A	PT6A-38 (2)	
C-12D	PT6A-41 (2)	
C-12E/F/J	PT6A-42 (2)	
C-17A	F117-PW-100 (4)	331-259(G) (1)
CEC-18A/B	TF33-PW-102A (2)	GTCP 36 (1)
C-20A	F113-RR-100 (2)	GTCP36-100 (1)
C-21A	TFE731-2/-2A (2)	
C-22	JT8D-9A (3)	GTCP85-98CK (1)
CV-22	T406-AD-400 (2)	
VC-25A	F103-GE-102 (4)	
C-32A (757-200)	F117-PW-100 (2)	331-49-7081 (1)
C-40B (737-700)	CFM56-7 (2)	131-9
C/NC/RC-130A	T56-A-9 (4)	GTC85-71A (1)
AC-130A	T56-A-9 (4)	GTC85-71A (1)
DC-130A	T56-A-9 (4)	GTC85-71A (1)
C-130D	T56-A-9 (4)	GTC85-71A (1)
C/HC/NC-130B	T56-A-7B (4)	GTC85-71A (1)
MC-130E	T56-A-7B (4)	GTC85-71A (1)
WC-130F	T56-A-7B (4)	GTC85-71A (1)
C/AC/DC/EC/HC/C/MC/NC/WC-130H	T56-A-15 (4)	GTCP85-180L (1)
HC-130N	T56-A-15 (4)	GTC8571A 1)
HC-130P	T56-A-15 (4)	GTC85-71A (1)
AC/130U	T56-A-15 (4)	GTC85-71A (1)
C-130J	AE2100D3 (4)	
C-172	O-320 (2)	
C-172RG	O-360 (2)	
C/EC/WC-135B	TF33-P-5 (4)	
C-135C	TF33-P-5 (4)	
RC-135N	TF33-P-5 (4)	
EC-135N	TF33-P-5 (4)	
EC-135P	TF33-P-5 (4)	
RC/TC-135S	TF33-P-5 (4)	

Aircraft Model	Aircraft Engine (Number)	[1]Auxiliary Power Units (Number)
RC-135V	TF33-P-5 (4)	
RC-135X	TF33-P-5 (4)	
RC/TC-135W	TF33-P-5 (4)	
EC-135C	TF33-P-9 (4)	
EC135J	TF33-P-9 (4)	
RC-135U	TF33-P-9 (4)	
C/EC/RC-135E	TF33-P-102 (4)	
KC/NKC-135E	TF33-P-102 (4)	T62T40LC-2 (1) GTCP85-180L (1) T41M-9A (1) ASHG70-1-1 (1)
KC-135-R	F108-CF-100 (4)	
C/NC-141A/B	TF33-P-/7-7A (4)	GTCP85-106/106A (1)
C-310	IO-520 (2)	
E-3B/C	TF33-PW-100A (4)	GTCP165-1/1A (2)
E-4B	F103-GE-100 (4)	GTCP660-4 (1)
E-6B	CFM56-2A (4)	
E-8C	TF33-P-102 (4)	
EF-111A	TF30-P-109 (4)	
F-111D	TF30-P-109 (4)	
F-15A/B/C/D	F100-PW-100 (2)	Jet Starter 384238-5-1 (1)
F-15C/D/E	F100-PW-220 (2)	Jet Starter 384238-5-1 (1)
F-15E	F100-PW-229 (2)	Jet Starter 384238-5-1 (1)
F-16A/B	F100-PW-200 (1)	T62T40-8 (1)
F-16C/D	F110-GE-100 (1)	T62T40-8 (1)
F-16C/D	F110-GE-129 (1)	T62T40-8 (1)
F-16C/D	F100-GE-229 (1)	T62T40-8 (1)
F-22A	F119-PW-100 (2)	
F117A	F404-GE-F1D2 (2)	3800100-4 (1)
T-1A	JT15D-5B (2)	
T-6A	PT6A-68 (1)	
T-37B	J69-T-25/-25A (2)	
AT/T-38A/B	J85-GE-5/-5B/-5F/-5G/-5H/-5J/-5L (2)	
T-41C	IO-360 (1)	
T-43C	JT8D-9A (1)	GTCP85-129 (1)
HH-1N	T53-L-13B (1)	
HH-3E	T58-GE-5 (2)	
CH-3E	T58-GE-5 (2)	
MH-53J	T64-GE-100 (2)	T62T27 (1)

Aircraft Model	AircraftEngine (Number)	[1]Auxiliary Power Units (Number)
NCH-53A	T64-GE-100 (2)	
TH-53A	T64-GE-100 (2)	
UH-1N	T400-CP-400 (1)	
UH-60A	T700-GE-700 (2)	T62T40-1 (1) GTC P36-151 (1)
RQ-1A/1B	Rotax-912 (1) Rotax 910 (1)	
RQ-3A	Williams FJ44 (1)	
RQ-4A	Allison AE3007 (1)	

OTHER MILITARY AIRCRAFT AND ENGINES

Aircraft Model	Aircraft Engine (Number)	[1]Auxiliary Power Units (Number)
A-4	J65-W-2, J52-W-8 (1)	
A-6	J52-P-8B (2)	
A-7	TF30-P-6, TF41A-400 (1)	
AH-1W	T700-GE-401 (2)	
AV-8	F402-RR-400 (1)	
C-2A	T56-A-8 (2)	
CH-3	T58-GE-5 (2)	
EP-3	T56-A-14 (4)	
F-4	J79-GE-8B (1)	
F-14	TF30-P-412 (2)	
F-18	F404-GE-400/404 (2)	
LC-130	T56-A-16 (4)	
S-3A	TF34-GE-400 (2)	
SH-2	T58-GE-8F (2)	

[1]Blank spaces mean that either the aircraft does not have or that no data is available on whether the aircraft has an auxiliary power unit.

Aircraft and engine data from the Air Force Engine Handbook, SA-ALC/LR, 1995 and the Federation of American Scientists, US Military Aircraft

TABLE 2-2
COMMERCIAL AIRCRAFT AND ENGINES

Aircraft	GE Engines (No. Engines)	P&W Engines (No. Engines)	RR Engines (No. Engines)	Other Manufacturers (No. Engines)
Airbus 300	CF6-50 (2) CF6-80 (2)	JT9D-7 (2)		
Airbus 310	CF6-80 (2)	JT9D-7 (2)		
Airbus 319		V2500 (2)		CFM56-5 (2)
Airbus 320		V2500 (2)		CFM56-5 (2)
Airbus 330	CF6-80 (2)	JT9D-7 (2)	Trent 700 (2)	
Airbus 340				CFM CFM56-5 (4)
Boeing 707		JT3D-3 TF33-P-7		CFM CFM56-2
Boeing 717 (MD-90)		V2500 (2)		
Boeing 727		JT8D-7 (3) JT8D-9 (3)		
Boeing 737-200		JT8D-9 (2)		
Boeing 737-300 To 500				CFM CFM56-3 (2)
Boeing 737-600 And 700				CFM CFM56-7 (2)
Boeing 747-200 And 400	CF6-50 (4) CF6-80 (4)	JT9D-7 (4) PW4074 (4) PW4077 (4)	RB211-524 (4)	
Boeng 757		PW2040 (2)	RB211-535 (2)	
Boeing 767	CF6-80 (2)	JT9D-7 (2) PW4074 (2) PW4077 (2)	RB211-524 (2)	
Boeing 777	GE90-76 (2) GE90-90 (2)	PW4084 (2) PW4090 (2) PW4098 (2)	Trent 772 (2) Trent 870s (2), 880s (2), 890s (2)	
DC-8		JT8D-7 (4) JT3D (4)		CFM CFM56-2 (4)
DC-9		JT8D-7 (2), 9,.11,15, 17		
MD-80		JT8D-200s (2)		
DC-10	CF6-50 CF6-6	JT9D-7 (3)		
MD-11	CF6-80	PW4460 (3)		

Aircraft	GE Engines	P&W Engines	RR Engines	Other Manufacturers
Beechjet 400		JT15D-5 (2)		
BH-1900		PT6A-65 (2), 67 (2)		
Bombadier			BR700-715 (2)	
Cessna 150				Textron O-200 (2)
Citation		JT15D-5		Garrett TFE731-2 (2)
DHC-6		PT6A-27 (2)		
DHC-7		PT-6A-50 (4)		
DHC-8		PW-120 (2)		
Embraer		PT6A-27 (2)		
Fokker F-28			RR Spey-MK555 (2)	
Fokker 100			TAY650 (2)	
Gulfstream III			F113-RR-100 (2)	
Gulfstream V			BR700-715 (2)	
Kingair		PT6A-41 (2)		
L-1011-500			RB211-524 (3)	
Learjet				Garrett TFE-231-2 (2)
Saab 340	CT7-9 (2)			
Short 360		PT6A-65 (2)		
Swearingen Metroliner				Garrett TFE731-2 (2)

Aircraft and engine data obtained from FAA Emissions and Dispersion Modeling System

TABLE 2-3
COMMERCIAL AIRCRAFT AUXILIARY POWER UNITS

Aircraft	Auxiliary Power Unit	Number (No./Aircraft)
Airbus 300	GTCP331-200ER GTCP 660 TSCP700-4B	1
Airbus 310	GTCP331-200 GTCP 85	1
Airbus 319	GTCP 36-300	1
Airbus 320	GTCP 36-300	1
Airbus 330	GTCP 85	1
Airbus 340	GTCP 331-350	1
Boeing 707	GTCP 85	1
Boeing 717 (MD-90)	GTCP 85	1
Boeing 727	GTCP 85-129	1
Boeing 737-200	GTCP 85-129	1
Boeing 737-300 To 500	GTCP 85-129	1
Boeing 737-600 And 700	131-9	1
Boeing 747-200 And 400	GTCP660 PW910A	1
Boeng 757	GTCP 331-200ER	1
Boeing 767	GTCP 331-200ER	1
Boeing 777	GTCP331-500	1
DC-8	GTCP 85 GTCP 85-129	1
DC-9	GTCP 85 GTCP 85-129	1
MD-80		1
DC-10	TSCP700-4B	1
MD-11	TSCP700-4B	1
Beechcraft 400	GTCP 36	1
BH-1900		
Bombadier	GTCP 85	1
Cessna 150		
Citation	GTCP 36	1
DHC-6	GTCP 36	1
DHC-7	GTCP 36	1
DHC-8	GTCP 36	1
Embraer	GTCP 36-150	1
Fokker F-28	GTCP 36	1
Fokker 100	GTCP 36-150	1
Gulfstream III	GTCP 36	1

Aircraft	Auxiliary Power Unit	Number (No./Aircraft)
Gulfstream V	GTCP 36	1
Kingair		
L-1011-500	GTCP 660	1
Learjet		
Saab 340		
Short 360	GTCP 36	1
Swearingen Metroliner	GTCP 36	1

Data from FAA Emissions and Dispersion Modeling System

SECTION 3
MILITARY AND COMMERCIAL GROUND SUPPORT EQUIPMENT

TABLE 3-1
MILITARY AIRCRAFT GROUND SUPPORT EQUIPMENT
(See "Generic All" for additional equipment associated with all aircraft.)

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
A-10A	AM32A-86D Generator		1.0	25%
	Start Cart A/M32A-60A A/M32A-95		 1.0 1.0	 100% 100%
	1H1 Heater		2.0	
	Hydraulic Test Stand MJ-2A		2.0	3000 psi
	Light Cart FL-1D NF-2		 2.0 2.0	
	Air Compressor MC-1A MC-2A		 2.0 1.0	 3000 psi 200 psi
	MJ1 Bomb Lift		1.0 to 8.0	100psi
		1 GTCP36-50	1.0	
B-1B	AM32A-86D Generator		2.2	50%
	A/M32A-95 Start Cart		0.5	
	AC/HT B-1B AC/HT H1		 2.4 4.0	
	Light Carts FL-1D NF-2		 0.5 0.5	
	MJ40 Bomb Lift		2.5	
		2 GTCP165-9	2.0	
B-2	AM32A-86D Generator		3.0	10%
	Start Carts A/M32A-60A A/M32A-95		 2.0 2.0	

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
	AC/HT Ace 401 H1 PD501		 12.0 2.0 12.0	
	Hydraulic Test Stand MJ-2/TTU-228 MJ-2/TTU-229 A/M27T-13		 1.0 1.5 4.0	 4000 psi
	Light Carts NF-2 FL-1D		 4.0 4.0	
	Air Compressor MC-1A MC-7 MC-6		 1.5 1.5 5.0	 125 psi 40 psi
	Bomb Lift MJ-40		 2.0	
		(2) 131-3A	4.0	
B-52	AM32A-86D Generator		 4.0	
	Start Carts A/M32A-95		 1.0	
	AC/HT MA-3D		 1.0	 11 ton BTU
	Light Cart NF-2		 1.0	
	Air Compressor MC-1A		 1.0	 3500 psi
	Bomb Lift MJ-1B		 2.0	
C-5A/B	Generator AM32A-86D		 13.0	 25%
	Start Carts A/M32A-95		 2.0	
	AC/HT MA-3D H1 BT400-46 HT		 3.0 to 12.0 9.0 10.0	

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
	Hydraulic Test Stand MJ-1 M32T1 MJ-2A		 1.0 1.0 1.0	
	Light Cart NF-2		 16.0	
	Air Compressor MC-2A MC-1A MC7		 16.0 7.0 2.0	 125 psi 125 psi 3000 psi
	Jacking Manifold A/M27M-1		 3.0	
		2 GTCP165-1B	 8.0	
C-9A	Generator AM32A-86D		 6.0	 50%
	Start Carts A/M32A-95		 0.5	
	AC/HT MA-3D H1		 6.0 6.0	
	Light Cart NF-2		 12.0	
	Air Compressor MC-2A MC-1A MC7		 2.0 0.5 2.0	
		1 GTCP85-98	6.0	
KC-10	Generator AM32-86D 90CU24P5		 12.0 12.0	 50% 50%
	Hydraulic Test Stand 9780-0023D 05-7056-3600		 2.0 2.0	 3000 psi 3000 psi
	Light Cart Onan Gen/Light Cart		 6.0	 100 amps

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
	Air Compressors MODP160WJDACJF		6.0	100 Amps
		1 TSCP700-4BQEC	6.0	
C-12A/D/E/F/J	Generator AM32A-86D		0.75	25%
C-17A	Generator AM32A-86D		2.0	
	Start Carts A/M32A-95		2.0	
	AC/HT MA-3D BT400-46HT H1		1.5	
	Light Cart NF-2		1.5	
	Air Compressor MC-1A MC7 MC-2A		0.66 0.66 0.66	
	Pressure Tester AF/M27M-1		0.5	
	Cargo Loader MJ-1B		1.5	
		(1)331 250G	0.5	
C-18A/B	See Generic 1			
		1 T41M-9A	0.5	
C-20A	Generator AM32A-86D		5.5	125V
	AC/HT Ace 8023293 AC MA-3D 1H1		1.0 1.0 3.0	
	Light Units FL-1D		6.0	
	Air Compressor MC-5 MC-8 MC-7 MC-2A		0.5 3.0 2 0.5	120 psi 120 psi 120 psi 200 psi
		GTCP 36-100	0,5	

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
C-21A	See Generic 1			
C-22	Generator AM32A-86D		1.5	
	Start Carts A/M32A-60		0.25	
	AC/HT H1		0.25	
	Light Cart NF-2		0.25	
	Air Compressor MC-1A MC7		0.25 0.25	
	Pressure Tester AF/M27M-1		0.25	
		1 GTCP85-98CK	1.0	
CV-22	See Generic 1			
VC-25A	See C-5A/B			
		See C-5A/B		
C-32A	Generator AM32A-86D		6.0	
		(1) 331-49-7081	3.0	
C-40B	See Generic 1			
		(1) 131-9	0.5	
C-130	Generator AM32A-86D Trielectron D200T400		4.0 to 11.0 3.0	40%
	Start Carts MA-1A A/M32A-60/A A/M32A-95		0.25 0.25 0.25	
	AC/HT Ace802-993AC MA-3D H1		1.0 1.0 1.0	
	Hydraulic Test Stand MJ-2A-1		3.0	

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
	Light Cart NF-2		2.0 to 10.0	
	Air Compressor MC-1A MC-2A		0.5 to 10.0 0,5 to 10.0	3000 psi
		1 GCTP71/71A (w T56 7B and 9D Eng.) 1 GTCP85L (w T56 15 Eng,)	1.0 1.0	
C-172/RG	See Generic 1			
C-135	Generator AM32A-86D		10.0	25%
	Start Carts A/M32A-60/A A/M32A-95		1.0 0.1	
	AC/HT Ace802-993AC MA-3C 1H1 H1		10.0 2.0 5.0 4.0	
	Light Cart NF-2		2.0	
	Air Compressor MC-1A		0.33	
		1 T41M-9A 1 ASHG70-1	1.0 to 2.0	
C/NC-141A/B	Generator AM32A-86D		0.5	
	Start Carts MD-3 A/M32A-60/A		0.1 0.5	
	AC/HT H1		0.4	
	Hydraulic Test Stand TTU228E M32T1		0.1 0.1	

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
	Light Cart NF-2		0.5	
	Air Compressor MC-1A MC-2A		0.1 0.1	
		1 GTCP85-106/106A	3.0	
C-310	See Generic 1			
E-3BC	See Generic 1			
		1 GTCP165-1/1A	1.0 to 2.0	
E-4B	See Generic 1			
		1 GTCP660-4	1.0 to 2.0	
E-6B	See Generic 1			
E-8C	Se Generic 1			
F/EF-111A/D	See Generic 2			
F-15	Generator AM32A-86D		0.33	
	Start Carts A/M32A-60/A A/M32A-95		0.33 0.33	
	AC/HT H1		0.5	
	Hydraulic Test Stand MJ-1-1 MJ-2/TTU-228		0.5 0.5	
	Light Cart NF-2		1.0 to 8.0	
	Air Compressor MC-1A MC11 MC-2A		0.33 2.0 0.25	
	Bomb Lift MJ1B		1.0	
		1 Jet Starter 384238-5-1	0.25	
F-16	Generator AM32A-86D		0.33	

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
	Start Carts A/M32A-60/A A/M32A-95		 0.33 0.33	
	AC/HT H1		 0.5	
	Hydraulic Test Stand MJ-1-1 MJ-2/TTU-228		 0.5 0.5	
	Light Cart NF-2		 1.0 to 8.0	
	Air Compressor MC-1A MC11 MC-2A		 0.33 2.0 0.25	
	Bomb Lift MJ1B		 1.0	
F-22	See Generic 2			
F-117	Generator AM32A-86D		 2.0	 50%
	Start Carts A/M32A-60/A A/M32A-95		 2.0 0.5	 1500 psi
	AC/HT ACE802-3293AC H1		 2.0 1.0	
	Hydraulic Test Stand MJ-1-1		 1.0	
	Light Cart NF-2		 1.0	
	Air Compressor MC-1A MC-2A		 0.33 0.33	 1500 psi
	Bomb Lift MJ1B			
		1 3800100-4	2.0	
T-1A	Generator Jetex		 0.33	 1000 amps

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
	Hydraulic Test Stand Airtron		0.1	
T-6A	Generator Jetex 40		0.5	28 VDC
	Start Cart Jet Series 703D		0.5	
	AC/HT MA-3D		0.75	150 F
	Hydraulic Test Stand 6X620-RDF		1.0	
	Light Cart FL-2D		1.0	
	Air Compressor MA-1A		0.5	
	Tug		0.33	
T-37B	Generator AM32A-36D		0.17	28 VDC
	HT/AC H1		0.17	150 F
	Hydraulic Test Stand MJ-1-1		0.5	3 gpm/1500psi
	Light Cart TL-1D		1.0	1000 Watts
	Air Compressor MC-1A MC-2A		0.5 0.5	1200 psi 120 psi
	Tug Small		0.33	
AT/T-38A/B	Generator AM32A-86D		0.25	28VDC
	Hydraulic Test Stand MK1 MK3A		0.75 0.75	9gpm/3000 psi
	Pressure Tester AF/M32J-1		1.0	120 psi
T-41B	Tug small		0.1	

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
T-43C	Generator AM32A-86D Essex B8098		 2.0 2.0	 28 VDC 28 VDC
	AC/HT MA-3D		 12.0	
	Hydraulic Test Stand HPE 45		 2.0	 3000 psi
	FL-1D		2.0	
	MC-1A		1.0	
		1 GTCP85-129	1.0 to 2.0	
HH-1N	Generator AM32A-86D		 1.0 to 16.0	 10%
	Start Cart M24A-9		 0.25	 28VDC
	AC/HT H-1		 8.0	
	Hydraulic Test Stand MJ2/TTU-229		 1.0	
	Light Units NF2D TF-1		 2.0 2.0	
	Air Compressor MC-1A MC-2A		 1.0 1.0	 300 psi 120 psi
HH-3E	See Generic 3			
CH-3E	See Generic 3			
MH-53J/M/NCH-53A/TH-53A	Generator AM32A-86D		 3.0	 10%
	AC/HT H1		 8.0	
	Hydraulic Test Stand MJ-2/TTU-228		 2.0	
	Light Carts NF2D FL-1D		 2.0 2.0	

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
	Air Compressor MC-2A		 4.0	
		1 T62T27	4.0	
UH-60A	Generator AM32A-86D		 1.0 to 5.0	 10%
	Start Cart AM32A-95		 0.5	
	AC/HT MA-3D H11		 2.0 2.0	
	Hydraulic Test Stand MJ-1-1 MJ-2/TTU-228		 2.5 1.0	
	Light Carts FL-1D		 0.5 to 4.0	 20 amps
	Air Compressor MC-1A MC-2A		 1/0 2.5	
		1 T62T40-1	1.0	
RQ-1A	Generator 805 806		 24.0 24.0	 80% 80%
	AC/HT MA-3D H1		 2.0 4.0	
	Light Cart FL-1D		 6.0	 80%
RQ-3A	See RQ-1A			
RQ-4A	See RQ-1A			
Generic 1 Cargo/Bomber (C-130)	Generator AM32A-86D Trielectron D200T400		 4.0 to 11.0 3.0	 40%
	Start Carts MA-1A A/M32A-60/A A/M32A-95		 0.25 0.25 0.25	

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
	AC/HT Ace802-993AC MA-3D H1		 1.0 1.0 1.0	
	Hydraulic Test Stand MJ-2A-1		 3.0	
	Light Cart NF-2		 2.0 to 10.0	
	Air Compressor MC-1A MC-2A		 0.5 to 10.0 0,5 to 10.0	 3000 psi
Generic 2 Fighter/Fighter Bomber (F-15)	Generator AM32A-86D		 0.33	
	Start Carts A/M32A-60/A A/M32A-95		 0.33 0.33	
	AC/HT H1		 0.5	
	Hydraulic Test Stand MJ-1-1 MJ-2/TTU-228		 0.5 0.5	
	Light Cart NF-2		 1.0 to 8.0	
	Air Compressor MC-1A MC11 MC-2A		 0.33 2.0 0.25	
	Bomb Lift MJ1B		 1.0	
		1 Jet Starter 384238-5-1	 0.25	
Generic 3 Helicopter (UH-60A)	Generator AM32A-86D		 1.0 to 5.0	 10%
	Start Cart AM32A-95		 0.5	

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
	AC/HT MA-3D H11		 2.0 2.0	
	Hydraulic Test Stand MJ-1-1 MJ-2/TTU-228		 2.5 1.0	
	Light Carts FL-1D		 0.5 to 4.0	 20 amps
	Air Compressor MC-1A MC-2A		 1/0 2.5	
Generic All	Diesel Aircraft Tug		 0.1	
	Diesel Package Tug		 1.3	
	Diesel Cargo Loader		 1.5	
	Diesel Fuel Truck		 0.6	
	Deicer Truck (cold weather bases only)		 0.15	

OTHER MILITARY AIRCRAFT

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
A-4	See Generic 2			
A-6	See Generic 2			
A-7	See Generic 2			
AH-1W	See Generic 3			
AV-8	See Generic 2			
C-2A	See Generic 3			
CH-3	See Generic 3			
EP-3	See Generic 1			
F-4	See Generic 2			
F-14	See Generic 2			

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)	Average Operating Load
F-18	See Generic 2			
LC-130	See Generic 1			
S-3A	See Generic 1			
SH-2	See Generic 3			

Data provide by USAF flight squadrons and the associated AGE shops, 2002. Generic equipment lists obtain from FAA Emission and Dispersion Modeling System

TABLE 3-2
COMMERCIAL AIRCRAFT AND GROUND SUPPORT EQUIPMENT

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)
Airbus 300	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP331-200ER 1 GTCP 660 1 GTCP 700-4B	0.4 0.4 0.4
Airbus 310	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP331-200 1 GTCP 85	0.4 0.4
Airbus 319	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 36-300	0.4
Airbus 320	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 36-300	0.4
Airbus 330	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)
	Gasoline Lavatory Truck		0.33
		1 GTCP 85	0.4
Airbus 340	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 331-350	0.4
Boeing 707	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 85	0.4
Boeing 717 (MD-90)	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 85	0.4
Boeing 727	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 85-129	0.4
Boeing 737-200	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 85-129	0.4

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)
Boeing 737-300 To 500	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 85-129	0.4
Boeing 737-600 And 700	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 131-9	0.4
Boeing 747-200 And 400	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP660 1 PW910A	0.4 0.4
Boeng 757	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 331 200ER	0.4
Boeing 767	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 331 200ER	0.4

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)
Boeing 777	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 331 500	0.4
DC-8	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 85 1 GTCP85-129	0.4 0.4
DC-9	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 85 1 GTCP85-129	0.4 0.4
MD-80	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 85-129	0.4
DC-10	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)
		1 TSCP 700-4B	0.4
MD-11	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 TSCP 700-4B	0.4
Beechcraft 400	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58
	Diesel Ground Power Unit		0.5
		1 GTCP 36	0.4
BH-1900	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58
	Diesel Ground Power Unit		0.5
Bombadier	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58
	Diesel Ground Power Unit		0.5
	Diesel Belt Loader		0.8
	Diesel Lavatory Truck		0.33
		1 GTCP 85	0.4
Cessna 150	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)
	Diesel Ground Power Unit		0.5
Citation	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58
	Diesel Ground Power Unit		0.5
	Diesel Belt Loader		0.8
	Diesel Lavatory Truck		0.33
		1 GTCP 36	0.4
DHC-6	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58
	Diesel Ground Power Unit		0.5
	Diesel Belt Loader		0.8
	Diesel Lavatory Truck		0.33
		1 GTCP 36	0.4
DHC-7	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58
	Diesel Ground Power Unit		0.5
	Diesel Belt Loader		0.8
	Diesel Lavatory Truck		0.33
		1 GTCP 36	0.4
DHC-8	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58
	Diesel Ground Power Unit		0.5
	Diesel Belt Loader		0.8
	Diesel Lavatory Truck		0.33
		1 GTCP 36	0.4
Embraer	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)
	Diesel Ground Power Unit		0.5
	Diesel Belt Loader		0.8
	Diesel Lavatory Truck		0.33
		1 GTCP 36-150	0.4
Fokker F-28	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 36	0.4
Fokker 100	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 36-150	0.4
Gulfstream III	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)
	Diesel Ground Power Unit		0.5
	Diesel Belt Loader		0.8
	Diesel Lavatory Truck		0.33
		1 GTCP 36	0.4
Gulfstream V	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58
	Diesel Ground Power Unit		0.5
	Diesel Belt Loader		0.8
	Diesel Lavatory Truck		0.33
		1 GTCP 36	0.4
Kingair	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58
	Diesel Ground Power Unit		0.5
	Diesel Belt Loader		0.8
	Diesel Lavatory Truck		0.33
L-1011-500	Diesel Ground Power Unit		0.5
	Diesel Air Conditioning Unit		0.5
	Diesel Aircraft Tug Wide		0.13
	Diesel Belt Loader		0.8
	Diesel Cargo Loader		1.5
	Diesel Container Loader		1.5
	Diesel Fuel Truck		0.58
	NF-2 Light Cart		1.75
	Gasoline Lavatory Truck		0.33
		1 GTCP 660	0.4

Aircraft	Ground Support Equipment	Auxiliary Power Unit	Operating Time Per LTO Cycle (Hr Operated)
Learjet	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58
	Diesel Ground Power Unit		0.5
	Diesel Belt Loader		0.8
	Diesel Lavatory Truck		0.33
Saab 340	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58
	Diesel Ground Power Unit		0.5
	Diesel Belt Loader		0.8
	Diesel Lavatory Truck		0.33
Short 360	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58
	Diesel Ground Power Unit		0.5
	Diesel Belt Loader		0.8
	Diesel Lavatory Truck		0.33
		1 GTCP 36	0.4
Swearingen Metroliner	Diesel Aircraft Tug Narrow		0.1
	Diesel Fuel Truck		0.58
	Diesel Ground Power Unit		0.5
	Diesel Belt Loader		0.8
	Diesel Lavatory Truck		0.33
		1 GTCP 36	0.4

Aerospace Ground Support Equipment data obtained from FAA Emissions and Dispersion Modeling System

SECTION 4
MILITARY AND COMMERCIAL AIRCRAFT ENGINE EMISSION FACTORS

TABLE 4-1
MILITARY AIRCRAFT ENGINE EMISSION FACTORS

Engine and Model Number	Engine Setting	Engine Fuel Flowrate lb/hr	Nox lb/hr	CO lb/hr	HC lb/hr	[1]Particulate lb/hr
F100-PW-100	Idle-out/Idle-in	1,097	4.80	38.71	9.43	2.26
	Approach	2,746	33.86	9.58	0.44	7.22
	Climbout	7,617	235.29	6.93	1.07	15.69
	Takeoff	54,074	357.97	517.49	2.70	62.19
F100-PW-200	Idle-out/Idle-in	1,016	5.07	27.04	8.41	2.09
	Approach	3,135	43.33	4.33	0.82	8.25
	Climbout	5,406	149.21	2.65	1.19	11.14
	Takeoff	40,247	282.94	381.14	5.63	46.28
F100-PW-220	Idle-out/Idle-in	1,084	5.00	38.27	8.61	2.23
	Approach	3,837	48.08	7.37	19.65	10.09
	Climbout	5,770	127.98	4.96	16.68	11.89
	Takeoff	41,682	348.88	499.77	63.77	47.93
F100-PW-229	Idle-out/Idle-in	1,087	4.13	11.04	0.41	2.24
	Approach	3,098	46.72	3.62	0.65	8.15
	Climbout	5,838	102.34	0.88	1.75	12.03
	Takeoff	20,793	1058.78	1593.16	338.09	23.91
F101-GE-102	Idle-out/Idle-in	1,117	4.58	27.33	0.00	2.42
	Approach	4,533	41.52	4.67	0.63	19.17
	Climbout	6,557	86.22	5.57	0.85	8.85
	Takeoff	15,314	258.96	665.70	946.71	43.80
F103-GE-100 & 101	Idle-out/Idle-in	1,706	6.14	105.41	37.19	4.69
	Approach	5,238	49.76	22.52	5.24	6.23
	Climbout	15,675	466.96	7.84	10.97	13.95
	Takeoff	19,738	721.23	9.87	11.84	23.29
F108-CF-100	Idle-out/Idle-in	1,136	4.48	30.89	1.05	10.31
	Approach	2,547	17.73	16.28	0.10	3.95
	Climbout	5,650	76.44	9.10	0.17	3.67
	Takeoff	6,458	98.68	4.07	0.19	10.27
F110-GE-100	Idle-out/Idle-in	1,044	5.42	25.14	1.06	1.92
	Approach	4,128	44.87	16.51	1.49	3.92
	Climbout	6,598	120.41	14.52	1.25	3.76
	Takeoff	16,374	254.62	1596.47	1135.21	54.69

Engine and Model Number	Engine Setting	Engine Fuel Flowrate lb/hr	Nox lb/hr	CO lb/hr	HC lb/hr	[1]Particulate lb/hr
F110-GE-129	Idle-out/Idle-in	1,036	3.30	35.82	2.74	2.70
	Approach	4,956	57.49	19.08	0.25	6.79
	Climbout	7,136	123.67	17.77	0.07	4.07
	Takeoff	16,826	253.74	1760.00	1090.32	56.20
F113-RR-100	Idle-out/Idle-in	1,088	3.91	34.49	4.00	0.00
	Approach	2,206	15.77	5.80	0.40	0.00
	Climbout	5,762	98.76	3.63	0.69	0.00
	Takeoff	7,072	160.04	84.58	0.64	0.00
F117-PW-100	Idle-out/Idle-in	1,104	4.37	26.34	2.37	11.64
	Approach	4,279	55.76	5.35	1.28	23.62
	Climbout	10,919	327.79	3.93	2.29	25.22
	Takeoff	13,976	479.38	5.59	0.42	32.28
F118-GE-100	Idle-out/Idle-in	1,097	4.72	23.02	0.65	1.37
	Approach	3,773	41.84	7.62	3.28	16.87
	Climbout	6,350	114.36	5.33	ND	11.30
	Takeoff	10,887	360.58	7.08	ND	17.85
F119-PW-100	Idle-out/Idle-in	1,377	4.14	66.30	9.40	3.37
	Approach	2,740	18.11	21.76	0.93	5.46
	Climbout	10,110	125.16	21.63	5.36	14.26
	Takeoff	18,612	369.22	13.96	ND	23.45
F404-GE-400/FID2	Idle-out/Idle-in	654	0.94	80.93	35.85	2.93
	Approach	3,110	22.21	9.86	2.64	4.54
	Climbout	6,503	103.53	8.58	1.76	10.21
	Takeoff	7,617	169.63	10.13	1.83	12.26
J69-25A	Idle-out/Idle-in	167	0.13	26.69	2.51	0.53
	Approach/ Climbout	872	2.55	33.35	0.06	0.81
	Takeoff	1,085	4.90	35.64	0.22	0.72
J85-GE-5H	Idle-out/Idle-in	506	1.07	80.06	7.76	2.38
	Approach	1,071	3.06	100.32	3.26	1.92
	Climbout	2,155	12.22	61.16	1.38	2.44
	Takeoff	8,138	17.01	115.48	18.64	2.03
JT-D-3B	Idle-out/Idle-in	1,068	1.92	124.99	114.23	5.32
	Approach	3,613	21.10	44.69	6.32	12.83
	Climbout	8,574	74.94	17.23	8.15	27.01
	Takeoff	9,790	121.30	4.41	5.19	35.93

Engine and Model Number	Engine Setting	Engine Fuel Flowrate lb/hr	Nox lb/hr	CO lb/hr	HC lb/hr	[1]Particulate lb/hr
JT15D-5B	Idle	221	0.48	23.90	17.59	1.10
	Approach	496	2.53	17.51	4.18	1.76
	Climbout	1,359	13.14	2.22	0.95	4.28
	Takeoff	1,630	18.42	0.33	0.16	4.11
PT6A-27	Idle-out/Idle-in	115	0.28	7.36	5.77	0.28
	Approach	215	1.80	5.01	0.47	0.52
	Climbout	400	2.80	0.48	0.00	0.96
	Takeoff	425	3.33	0.43	0.00	1.02
PT6A-41 & 42	Idle-out/Idle-in	147	0.29	16.92	7.37	0.35
	Approach	273	1.27	9.49	6.19	0.66
	Climbout	473	3.57	3.07	0.96	1.14
	Takeoff	510	4.07	2.60	0.89	1.22
PT6A-68	Idle-out/Idle-in	155	0.32	19.43	6.08	0.61
	Approach	331	1.30	7.71	1.18	1.37
	Climbout	517	3.32	4.81	0.13	1.73
	Takeoff	634	5.35	4.64	0.13	2.40
T56-A-7	Idle-out/Idle-in	740	4.16	11.17	5.62	2.69
	Approach	924	6.08	5.04	0.67	3.56
	Climbout	1,611	16.30	3.93	0.53	2.35
	Takeoff	2,105	24.21	5.18	0.48	2.57
T56-A-9	Idle-out/Idle-in	740	5.53	4.16	1.67	2.69
	Approach	949	6.98	4.08	0.73	3.65
	Climbout	1,724	16.19	4.21	0.88	2.52
	Takeoff	2,068	23.14	5.19	0.72	2.52
T56-A-15	Idle-out/Idle-in	900	6.74	3.46	1.77	3.28
	Approach	1,240	10.30	3.50	0.72	4.77
	Climbout	2,180	21.12	3.60	0.92	3.18
	Takeoff	2,456	28.05	4.35	0.69	3.00
T406-AD-400	Idle-out/Idle-in	362	1.50	3.02	0.04	1.32
	Approach	663	4.01	2.30	0.01	2.55
	Climbout	948	7.46	1.73	0.02	1.38
	Takeoff	2,507	45.20	0.73	0.03	3.06
TF30-P-109	Idle-out/Idle-in	761	2.23	37.17	20.24	1.20
	Approach	2,900	16.82	56.55	15.69	4.58
	Climbout	5,900	56.58	30.44	4.84	9.32
	Takeoff	38,460	187.68	238.07	5.77	60.77
TF33-P-3/103	Idle-out/Idle-in	900	1.25	85.55	81.82	1.12
	Approach	3,800	24.21	19.91	5.21	5.09

Engine and Model Number	Engine Setting	Engine Fuel Flowrate lb/hr	Nox lb/hr	CO lb/hr	HC lb/hr	[1]Particulate lb/hr
	Climbout	6,240	49.17	13.17	9.36	10.30
	Takeoff	7,440	89.88	0.00	4.09	3.87
TF33-P-5&9	Idle-out/Idle-in	1,120	1.56	106.47	101.82	5.58
	Approach	4,140	26.37	21.69	5.67	14.70
	Climbout	8,960	70.60	18.91	13.44	28.22
	Takeoff	9,630	116.33	0.00	4.82	35.34
TF33-P-7/7A	Idle-out/Idle-in	1,055	1.58	144.49	138.37	5.25
	Approach	3,982	24.77	58.14	14.41	14.14
	Climbout	7,632	64.64	22.59	2.98	24.04
	Takeoff	9,108	104.65	10.84	2.28	33.43
TF33-P-100	Idle-out/Idle-in	1,108	1.66	151.75	145.33	6.79
	Approach	2,794	17.38	40.79	10.11	15.26
	Climbout	8,069	68.34	23.88	3.15	42.69
	Takeoff	10,856	124.74	12.92	2.71	31.81
TF33-P-102&102A	Idle-out/Idle-in	1,065	1.92	124.64	113.91	6.53
	Approach	3,912	22.85	48.39	6.81	21.36
	Climbout	6,985	61.05	14.04	6.64	36.95
	Takeoff	8,756	108.49	3.94	4.64	25.66
TF34-GE-100-[illegible]	Idle-out/Idle-in	449	0.61	38.92	9.29	3.59
	Approach	773	3.11	19.83	1.15	4.78
	Climbout	1,516	9.73	9.52	0.97	13.54
	Takeoff	3,026	26.72	12.10	1.21	8.08
TF39-GE-1C	Idle-out/Idle-in	1,448	4.87	84.29	23.79	3.98
	Approach	10,447	258.25	8.04	7.00	12.43
	Climbout	12,541	353.15	20.44	0.00	11.16
	Takeoff	13,861	452.70	17.74	0.00	16.36
TFE731-2/2A	Idle-out/Idle-in	206	0.72	9.85	1.76	0.49
	Approach	571	3.94	8.88	0.81	1.37
	Climbout	1,476	23.73	2.39	0.10	3.54
	Takeoff	1,786	34.20	2.02	0.11	4.29
T53-L-13	Idle-out/Idle-in	206	0.72	9.85	1.76	0.49
	Approach	571	3.94	8.88	0.81	1.37
	Climbout	1,476	23.73	2.39	0.10	3.54
	Takeoff	1,786	34.20	2.02	0.11	4.29
T58-GE-5	Idle-out/Idle-in	133	0.16	23.22	11.47	0.20
	Approach	623	3.58	8.65	0.70	1.38

Engine and Model Number	Engine Setting	Engine Fuel Flowrate lb/hr	Nox lb/hr	CO lb/hr	HC lb/hr	[1]Particulate lb/hr
	Climbout	757	4.85	7.67	1.06	1.97
	Takeoff	821	5.56	7.67	2.41	2.13
T64-GE-100	Idle-out/Idle-in	284	0.46	21.43	7.94	0.67
	Approach	1,217	6.68	6.05	0.24	2.40
	Climbout	1,714	12.77	3.17	0.10	2.76
	Takeoff	1,882	15.07	5.59	0.55	1.73
T400-CP-400	Idle-out/Idle-in	138	0.42	4.11	1.44	0.33
	Approach	143	0.44	4.39	1.24	0.34
	Climbout	283	1.39	0.75	0.05	0.68
	Takeoff	412	2.75	0.31	0.05	0.99
T700-GE-700	Idle-out/Idle-in	133	0.37	7.07	7.54	0.20
	Approach	500	3.78	2.63	0.19	0.63
	Climbout	589	4.82	2.21	0.29	1.31
	Takeoff	706	6.08	2.18	0.35	1.84

[1] Shaded areas indicate that the particulate emission factor is the average particulate emission factor from the Aircraft Engine and Auxiliary Power Unit Emissions Characterization Study, AFIERA, 1999 (2.4 lb/1000 lb fuel).

Engine emission factor from "Air Emissions Inventory Guidance Document for Mobile Sources at Air Force Installations", AFIERA January 2002.

TABLE 4-2
COMMERCIAL AIRCRAFT ENGINE EMISSION FACTORS

Engine Model Number	Engine Setting	Engine Fuel Flowrate (lb/hr)	NOx (lb/hr)	CO (lb/hr)	HC (lb/hr)	Particulate (lb/hr)
TFE731-2-2B	Idle	190.48	2.82	58.6	20.04	0.46
	Approach	531.75	5.90	22.38	4.26	1.27
	Climbout	1,373.04	13.08	2.03	0.128	3.29
	Takeoff	1,627.01	15.25	1.394	0.114	3.9
BR700-715C1-30	Idle	833.35	4.26	17.875	0.06	2.0
	Approach	2,158.77	8.23	3.23	0.02	2.58
	Climbout	6,389.00	20.05	0.64	0.06	15.33
	Takeoff	7,809.66	27.92	0.80	0.01	18.74
CFM56-2A	Idle	1,031.76	4.3	23.5	1.13	2.47
	Approach	2,523.08	8.7	3.4	0.08	6.05
	Climbout	7,203.28	17.3	0.9	0.04	17.29
	Takeoff	8,841.42	20.4	0.9	0.04	21.22
CFM56-3B1	Idle	904.78	3.9	34.4	2.28	2.17
	Approach	2,301.63	8.3	3.8	0.08	5.52
	Climbout	6,285.82	15.5	0.95	0.05	15.09
	Takeoff	7,508.06	17.7	0.9	0.04	18.02
CFM56-3C-1	Idle	964.14	4.3	26.8	1.42	2.31
	Approach	2,666.71	9.1	3.1	0.07	6.4
	Climbout	7,571.56	17.8	0.9	0.04	18.17
	Takeoff	9,158.88	20.7	0.9	0.03	21.98
CFM56-5A1	Idle	802.39	4.0	17.6	1.4	1.92
	Approach	2,309.56	8.0	2.5	0.40	5.54
	Climbout	6,841.38	19.6	0.9	0.23	16.42
	Takeoff	8,341.41	24.6	0.9	0.23	20.02
CFM56-5B1	Idle	928.59	4.6	28.40	3.21	2.23
	Approach	2,888.94	10.8	1.57	0.12	6.93
	Climbout	8833.48	27.2	0.50	0.10	21.2
	Takeoff	10,785.90	35.1	0.50	0.10	25.89
CFM56-5C2	Idle	932.56	4.19	34.0	5.68	2.24
	Approach	2,823.86	10.0	1.75	0.062	6.78
	Climbout	8,539.83	25.8	0.80	0.008	20.5
	Takeoff	10,381.13	32.6	0.93	0.008	24.91
CFM56-7B20	Idle	793.66	4.30	25.90	3.10	1.9
	Approach	2,174.64	9.50	3.20	0.10	5.22
	Climbout	6,039.78	17.4	0.50	0.10	14.5
	Takeoff	7,246.15	20.5	0.60	0.10	17.4

Engine Model Number	Engine Setting	Engine Fuel Flowrate (lb/hr)	NOx (lb/hr)	CO (lb/hr)	HC (lb/hr)	Particulate (lb/hr)
CF6-50C	Idle	1,682.57	3.5	62.3	23.0	4.04
	Approach	5,103.26	9.4	5.2	1.0	12.25
	Climbout	15,198.67	29.0	0.5	0.7	36.48
	Takeoff	18,881.27	35.0	0.5	0.6	45.31
CF6-50E	Idle	1,293.67	3.4	24.04	2.72	3.10
	Approach	5,261.99	10.16	3.71	0.28	12.63
	Climbout	15,397.08	25.50	0.45	0.15	36.95
	Takeoff	18,738.41	28.97	0.45	0.14	44.97
CF6-6K	Idle	1,371.45	4.5	54.2	21.0	3.31
	Approach	3,804.54	11.4	6.5	0.7	9.13
	Climbout	11,357.33	32.6	0.5	0.3	27.26
	Takeoff	13,778.01	40.0	0.5	0.3	33.07
CF6-80A	Idle	1,190.50	3.4	28.2	6.29	2.86
	Approach	4,881.03	10.3	3.1	0.47	11.71
	Climbout	14,246.27	25.6	1.1	0.29	34.19
	Takeoff	17,024.10	29.8	1.1	0.29	40.86
CF6-80C2A2	Idle	1,523.84	4.49	21.97	1.90	3.66
	Approach	4,682.62	11.86	2.56	0.12	11.24
	Climbout	14,055.79	18.37	0.05	0.05	33.73
	Takeoff	17,079.65	22.35	0.04	0.05	40.99
GE90-76B	Idle	2,380.99	5.88	40.35	3.42	5.71
	Approach	6,190.56	12.68	5.80	0.67	14.86
	Climbout	18,492.37	35.39	0.13	0.06	44.38
	Takeoff	22,460.70	44.86	0.09	0.07	53.9
GE90-90B	Idle	2,484.17	6.11	35.79	2.77	5.96
	Approach	7,015.99	10.62	23.48	1.34	16.84
	Climbout	21,873.38	43.92	0.11	0.07	52.51
	Takeoff	27,135.38	57.34	0.08	0.08	65.12
V2500-A1	Idle	964.14	5.91	7.76	0.22	2.31
	Approach	2,650.84	13.45	0.77	0.15	6.36
	Climbout	7,333.46	30.82	0.55	0.11	17.6
	Takeoff	8,833.48	37.13	0.55	0.11	21.2
V2533-A5	Idle	1,081.76	5.24	9.317	0.100	2.6
	Approach	3,098.06	10.83	1.65	0.052	7.44
	Climbout	9,085.07	26.67	0.515	0.043	2.18
	Takeoff	11,320.83	36.48	0.463	0.047	27.17
JT150-5C	Idle	219.05	1.08	124.60	96.67	0.53
	Approach	538.10	5.23	49.24	16.0	1.29
	Climbout	1,430.18	9.79	4.18	0.67	3.43
	Takeoff	1,707.17	9.93	2.52	0	4.1

Engine Model Number	Engine Setting	Engine Fuel Flowrate (lb/hr)	NOx (lb/hr)	CO (lb/hr)	HC (lb/hr)	Particulate (lb/hr)
JT3D-3B	Idle	1,071.45	2.5	98.0	112.0	2.57
	Approach	2,746.06	4.8	24.5	4.0	6.59
	Climbout	7,396.95	9.9	2.8	2.0	17.75
	Takeoff	9,317.62	12.1	1.5	4.0	22.36
JT3D-7 series	Idle	1,015.89	2.20	138.99	123.00	2.44
	Approach	3,067.35	5.3	19.50	2.10	7.36
	Climbout	8,190.61	9.59	1.90	0.40	19.66
	Takeoff	9,952.55	12.69	0.89	0.50	23.89
JT8D-11	Idle	1,154.78	2.75	35.0	10.0	2.77
	Approach	2,650.04	5.8	9.4	1.4	6.36
	Climbout	7,250.92	14.6	1.9	0.45	17.4
	Takeoff	8,896.98	18.9	1.2	0.40	21.35
JT8D-15	Idle	1,172.24	3.0	35.2	11.0	2.81
	Approach	2,700.84	5.9	9.6	1.65	6.48
	Climbout	7,500.13	15.0	1.0	0.25	18.0
	Takeoff	9,349.36	19.1	0.7	0.25	22.44
JT8D-17	Idle	1,166.69	3.3	31.00	10.2	2.8
	Approach	2,809.57	6.10	8.54	1.96	6.74
	Climbout	7,912.83	15.23	1.00	0.79	17.26
	Takeoff	9,681.12	19.20	0.74	0.69	23.23
JT8D-9 series	Idle	1,047.64	2.90	34.5	10.00	2.51
	Approach	2,365.12	5.64	9.43	1.73	5.68
	Climbout	5,714.40	14.21	1.66	0.47	13.71
	Takeoff	8,254.11	17.92	1.24	0.47	19.81
JT9D-7A	Idle	1,674.63	3.1	83.6	36.1	4.02
	Approach	4,912.78	7.6	7.6	1.3	11.79
	Climbout	14,198.65	28.5	0	0.1	34.08
	Takeoff	16,659.01	38.7	0	0.1	39.98
PW2040	Idle	1,230.18	4.2	25.1	2.25	2.95
	Approach	6,428.68	10.6	2.0	0.18	15.43
	Climbout	11,492.26	27.3	0.4	0.035	27.58
	Takeoff	13,976.43	34.3	0.4	0.026	33.54
PW4074D	Idle	1,896.86	3.81	34.34	5.07	4.55
	Approach	6,428.68	11.88	0.64	0.08	15.43
	Climbout	19,174.93	34.48	0.25	0.05	46.02
	Takeoff	23,405.15	42.35	0.23	0.03	56.17
PW4077	Idle	1,841.30	4.2	20.2	3.0	4.42
	Approach	6,476.30	11.3	0.4	0.2	15.54
	Climbout	19,460.64	32.5	0.1	0.1	46.7
	Takeoff	23,960.72	39.8	0.1	0.1	57.51

Engine Model Number	Engine Setting	Engine Fuel Flowrate (lb/hr)	NOx (lb/hr)	CO (lb/hr)	HC (lb/hr)	Particulate (lb/hr)
PW4084D	Idle	2,047.65	53.02	25.74	3.29	4.91
	Approach	7,198.53	39.47	0.48	0.06	17.28
	Climbout	21,992.43	12.70	0.24	0.03	52.78
	Takeoff	27,865.55	4.08	0.18	0.03	66.88
PW4090	Idle	2,127.02	4.29	20.63	2.30	5.10
	Approach	7,595.37	13.19	0.44	0.06	18.23
	Climbout	23,627.38	42.80	0.23	0.03	56.71
	Takeoff	30,937.03	61.00	0.19	0.03	74.25
PW4460	Idle	1,690.50	4.9	20.32	1.66	4.06
	Approach	5,579.46	12.0	1.78	.014	13.39
	Climbout	16,547.90	24.7	0.51	0.03	39.72
	Takeoff	21,008.29	32.8	0.37	0.10	50.42
RB211-524G	Idle	2,063.53	4.63	13.74	3.28	4.95
	Approach	5,555.65	9.56	1.01	1.14	13.33
	Climbout	16,508.21	40.54	0.43	1.46	39.62
	Takeoff	20,794.00	58.71	0.59	2.28	49.90
RB211-535E4B	Idle	1,507.96	3.52	11.75	0.28	3.62
	Approach	4,365.15	7.35	1.05	0.03	10.48
	Climbout	13,095.46	36.82	0.60	0.00	31.43
	Takeoff	16,508.21	54.46	0.94	0.001	39.62
SPEY Mk555	Idle	761.92	3.7	29.3	1.86	1.83
	Approach	1,754.00	6.8	3.7	0.29	4.21
	Climbout	4,698.49	16.5	0.7	0.15	11.28
	Takeoff	5,833.43	21.9	0.3	0.29	14.00
TAY Mk650-15	Idle	944.46	1.70	33.77	3.29	2.27
	Approach	2,015.91	4.55	6.54	0.88	4.84
	Climbout	5,674.70	16.47	2.01	0.41	13.62
	Takeoff	6,936.62	19.81	1.74	0.37	16.65
Trent 772	Idle	2,222.26	4.71	17.94	1.46	5.33
	Approach	6,746.15	10.3	0.89	0.01	16.19
	Climbout	20,476.53	26.44	0.16	0	49.14
	Takeoff	25,397.25	34.38	0.2	0	60.95
Trent 875	Idle	2,222.26	4.64	19.66	1.78	5.33
	Approach	6,984.24	10.43	0.86	0	16.76
	Climbout	20,397.17	26.55	0.16	0	48.95
	Takeoff	24,603.59	33.32	0.19	0	59.05

Engine Model Number	Engine Setting	Engine Fuel Flowrate (lb/hr)	Nox[1] (lb/hr)	CO[1] (lb/hr)	HC[1] (lb/hr)	Particulate[2] (lb/hr)
Trent 877	Idle	2,222.26	4.75	18.42	1.55	5.33
	Approach	7,142.98	10.59	0.80	0	17.14
	Climbout	21,111.47	27.59	0.16	0	50.67
	Takeoff	25,476.62	34.76	0.20	0	61.14
Trent 884	Idle	2,460.36	5.04	15.19	1.00	5.90
	Approach	7,698.54	11.07	0.65	0	18.48
	Climbout	22,936.89	30.63	0.18	0	55.05
	Takeoff	28,254.44	40.05	0.24	0	67.81
Trent 892	Idle	2,380.99	5.33	13.07	0.7	5.71
	Approach	7,936.64	11.58	0.57	0	19.05
	Climbout	2,4603.59	33.3	0.2	0	59.05
	Takeoff	3,1032.27	45.7	0.28	0.01	74.48
Trent 895	Idle	2,619.09	5.11	14.71	0.89	6.29
	Approach	8,333.47	11.39	0.54	0.00	20.0
	Climbout	25,317.89	34.29	0.19	0.00	60.76
	Takeoff	31,984.66	47.79	0.27	0.02	76.76

1. Emission factors obtained from ICAO Database
2. Particulate emission factor is the average particulate emission factor from the Aircraft Engine and Auxiliary Power Unit Emissions Characterization Study, AFIERA, 1999. (2.4 lb/1000 lb of fuel)

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SECTION 5
MILITARY AND COMMERCIAL GROUND SUPPORT EQUIPMENT EMISSION FACTORS

TABLE 5-1
MILITARY AIRCRAFT GROUND SUPPORT EQUIPMENT EMISSION FACTORS

Ground Support Equipment and Auxiliary Power Units	NOX LB/HR	CO LB/HR	HC LB/HR	PART LB/HR
AM32A-86D Generator (148 HP)[1]	6.08	0.13	0.21	0.09
Trielectron D200 T400(236 HP)[1]	8.61	0.22	0.28	0.08
Ground Mobile Gen Set(150 HP)[1]	6.85	1.11	0.16	0.12
Essex 90CU24P5[3]				
Jetex[3]				
AM32A-60A Start Cart (180 HP)[1]	1.82	5.48	0.27	0.21
AM32A-95(155 HP)[1]	1.47	5.86	0.07	0.11
Ace 802-329 AC(272 HP)[1]	2.94	0.15	0.20	0.20
Ace 401[1]	7.97	1.52	0.20	0.21
B-1B AC(300 HP)[1]	7.65	1.41	0.26	0.15
MA-3D AC(120 HP)[1]	0.64	0.06	0.06	0.28
1H1 Heater(6.5 HP)[1]	0.16	0.18	0.02	NDA
H1(6.5 HP)[1]	0.16	0.18	0.02	NDA
BT-400-46(6.5 HP)[1]	0.16	0.18	0.02	NDA
PD501[1]	7.65	1.41	0.26	0.15
MJ-1-1(97 HP)[1]	0.76	0.04	0.03	NDA
MJ-2A[1]	3.85	2.46	0.19	0.08
MJ-2/TTU-228(125 HP)[1]	3.26	0.76	0.19	0.08
MJ-2/TTU-229(125 HP)[1]	3.39	2.46	0.19	0.08
M32T1[3]				
A/M27T-13 Jacking Manifold (30 HP)[1]	0.18	12.25	0.28	NDA
Onan Generator Light Cart (10.5 HP)[1]	0.17	0.13	ND	0.16
NF2[2]	0.05	2.47	0.02	0.00
TF-1	0.17	0.13	ND	0.16
MC-1A(18.4 HP)[1]	0.50	0.23	0.18	NDA
MC-2A[3]				

Ground Support Equipment and Auxiliary Power Units	NOX LB/HR	CO LB/HR	HC LB/HR	PART LB/HR
MC-5(130 HP)	0.55	0.03	0.11	NDA
MC-7(48-52 HP)	0.41	0.01	0.05	NDA
MC11(18.4 HP)[1]	0.42	0.27	0.27	0.07
MJ-40 Bomblift[3]	0.34	0.21	0.21	0.06
MJ-1B Cargo Loader	4.78	3.04	3.04	0.80
Elevator Loader[2]	3.12	1.12	0.13	0.06
Diesel Aircraft Tug Narrow[2]	1.54	0.56	0.17	0.07
Diesel Aircraft Tug Wide[2]	4.40	1.60	0.48	0.20
Diesel Belt Loader[2]	0.25	0.09	0.02	0.02
Diesel Cabin Service[2]	0.23	0.22	0.04	0.02
Diesel Bagage Tug[2]	0.47	0.17	0.05	0.02
Diesel Cargo Loader[2]	0.42	0.15	0.05	0.02
Diesel Container Loader[2]	0.23	0.22	0.04	0.02
Diesel Fuel Truck[2]	0.49	0.18	0.05	0.02
Diesel Deicer[2]	0.97	0.35	0.11	0.04

[1]Data from Air Emissions Inventory Guidance Document for Mobile Sources at Air Force Installations, Jan 2002

[2]Data from FAA Emissions and Dispersion Modeling System

[3]No emission factors available fot this AGE.

NDA No Data Available

TABLE 5-2
COMMERCIAL AIRCRAFT GROUND SUPPORT EQUIPMENT EMISSION FACTORS

Ground Support Equipment and Auxiliary Power Units	NOX LB/HR	CO_ LB/HR	HC LB/HR	PART LBKG/HR
Diesel Air Conditioning Unit	2.48	0.90	0.27	0.11
Diesel Aircraft Tug Narrow	1.54	0.56	0.17	0.07
Diesel Aircraft Tug Wide	4.40	1.60	0.48	0.20
Diesel Belt Loader	0.25	0.09	0.02	0.02
Diesel Cabin Service	0.23	0.22	0.04	0.02
Diesel Cargo Loader	0.42	0.15	0.05	0.02
Diesel Container Loader	0.23	0.22	0.04	0.02
Diesel Deicer	0.97	0.35	0.11	0.04
Diesel Fuel Truck	0.50	0.18	0.05	0.02
Diesel GPU Transporter	0.31	0.30	0.06	0.02
Diesel Ground Power Unit	1.20	0.44	0.13	0.05
1H1 Heater	0.29	0.06	0.03	0.02
NF-2 Light Cart	0.05	2.47	0.16	0.00

Data from FAA Emissions and Dispersion Moodeling System

SECTION 6
MILITARY AND COMMERCIAL AUXILIARY POWER UNIT EMISSION FACTORS

TABLE 6-1
MILITARY AND COMMERCIAL AIRCRAFT AUXILIARY POWER UNIT EMISSION FACTORS

Ground Support Equipment and Auxiliary Power Units	NOX LB/HR	CO LB/HR	HC LB/HR	PART LB/HR
APU GTCP30-300	1.29	0.00	0.03	ND
APU GTCP 36 (80HP)	1.01	0.21	0.02	ND
APU GTCP 36-50(120 HP)[1]	1.51	2.59	0.16	0.22
APU GTCP 36-150	0.31	0.44	0.04	ND
APU GTCP 36-300[1]	1.51	2.59	0.16	0.22
APU GTCP 85 (200 HP)	0.51	1.92	0.11	ND
APU GTCP 85-98[1]	1.51	2.59	0.16	0.22
APU GTCP 85-106/106A(32 HP)[1]	1.51	2.59	0.16	0.22
APU GTCP 85-129 (200 HP)	0.51	1.92	0.11	ND
APU 85-180(177 HP)[2]	4.45	14.87	1.02	0.47
APU GTCP 71/71A[1]	1.51	2.59	0.16	0.22
APU 131-9	0.77	0.56	0.04	ND
APU 131-3A[1]	1.51	2.59	0.16	0.22
APU GTCP 165-9(135 HP)[3]	1.23	3.80	0.07	0.13
APU GTCP 165-1A(128 HP)[2]	1.23	3.80	0.07	0.13
APU GTCP331-200ER (143 HP)	1.16	0.50	0.05	ND
APU GTCP 331-250	3.43	1.40	0.15	0.16
APU GTCP 331-350	2.03	0.38	0.05	ND
APU GTCP331-500 (143 HP)	2.77	0.46	0.05	ND
APU GTCP 660 (300 HP)	1.85	3.01	0.10	ND
APU TSCP 700 (142 HP)	1.73	0.78	0.08	ND
APU TSCP700-4B (142 HP)	1.73	0.78	0.08	ND
APU 3800100-4[1]	1.51	2.59	0.16	0.22
APU PW910A	1.23	6.57	0.59	ND
APU T62T27(65 HP)[2]	4.63	36.15	6.23	0.22
APU T41M-9A[1]	1.51	2.59	0.16	0.22

Data from FAA Emissions and Dispersion Modeling System unless otherwise specified

[1]Average emission rate of all other APU's where emissions were measured.

[2]Air Emissions Inventory Guidance Document for Mobile Sources at Air Force Installations

[3]Emission Factors from APU GTCP 165-1A

ND No Data

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